

ABSTRACT OF THE DISCLOSURE

A modular, compact and widely tunable laser system for the efficient generation of high peak and high average power ultrashort pulses. Modularity is ensured by the implementation of interchangeable amplifier components. System compactness is ensured by employing efficient fiber amplifiers, directly or indirectly pumped by diode lasers. Peak power handling capability of the fiber amplifiers is expanded by using optimized pulse shapes, as well as dispersively broadened pulses. ~~Dispersive broadening is introduced by dispersive pulse stretching in the presence of self-phase modulation and gain, resulting in the formation of high-power parabolic pulses. In addition, dispersive broadening is also introduced by simple fiber delay lines or chirped fiber gratings, resulting in a further increase of the energy handling ability of the fiber amplifiers. The phase of the pulses in the dispersive delay line is controlled to quartic order by the use of fibers with varying amounts of waveguide dispersion or by controlling the chirp of the fiber gratings. After amplification, the dispersively stretched pulses can be re-compressed to nearly their bandwidth limit by the implementation of another set of dispersive delay lines. To ensure a wide tunability of the whole system, Raman-shifting of the compact sources of ultrashort pulses in conjunction with frequency-conversion in nonlinear optical crystals can be implemented, or an Anti-Stokes fiber in conjunction with fiber amplifiers and Raman-shifters are used. A particularly compact implementation of the whole system uses fiber oscillators in conjunction with fiber amplifiers. Additionally, long, distributed, positive-dispersion optical amplifiers are used to improve transmission characteristics of an optical communication system. Finally, an optical communication system utilizes a Raman amplifier fiber pumped by a train of Raman-shifted, wavelength-tunable pump pulses, to thereby amplify an optical signal which counterpropagates within the Raman amplifier fiber with respect to the pump pulses.~~